REMARKS

This amendment is responsive to the Office Action of December 5, 2006. Reconsideration and allowance of claims 1-18 and 20 are requested.

The Office Action

Claims 1-18 stand rejected under 35 U.S.C. § 103 as being unpatentable over Horiuchi (US 6,137,858) in view Wood (US 2002/0070970; see also US 6,925,200).

The Present Application

The present application is directed to a new and improved method and apparatus for reviewing tomographic scans with a large number of images [0006].

With reference to claim 1, a diagnostic medical imaging system **100** has an examination region **112** in which a subject being examined is positioned [0022]. The imaging apparatus obtains a plurality of first image slices of the subject, having a first thickness [0023]. See also [0002] and [0028] in which the slices, also referenced as thin axial cross-section slices, having a thickness of 0.5 mm are discussed. The axial cross-section slice images are stored in an image memory or other storage device that is a part of workstation **150** [0028]. For a whole-body scan at the discussed 0.5 mm slices, on the order of 4,000 slices are generated (for the Kennewick Man who was recently in the news, a whole-body scan with 0.39 mm slices was taken). For even a modest 20 cm (8 in) scan range, 400 0.5 mm axial cross-section slices would be generated [0002]. This is a vast number of slices to deal with [0003], leading to the drawbacks referenced in [0004] and [0005].

To overcome these problems, a data processor in the workstation **150** combines subsets, e.g., n contiguous thin slices are combined to create what is referred to herein as a thick slice [0029]. In this manner, a set of second, thicker slices is generated by combining the subsets of first, thin image slices [0029]. A display **152** includes a plurality of view ports including a first view port (Figure 2) which depicts one or more of the selected second, thick image slices and a second view port (Figure 3) which depicts one or more of the first, thin image slices which

are constituents of one of the second, thick image slices which are depicted in the first view port [0030]. In this manner, the radiologist can review the thick slice images when high resolution is not needed, reducing the time burden on the radiologist. But, the radiologist is free to conduct a review with the higher resolution thin slice images in the second view port in regions in which a more in-depth examination is desired [0039].

With reference to claim 6, a diagnostic medical imaging system includes an acquisition means **100** for acquiring a plurality of the first (thin) image slices [0027], [0035]. A combining means in the workstation **150** generates a plurality of second (thick) image slices from combined subsets of the first (thin) image slices, the subsets including a plural number n of contiguous first (thin) image slices. The second (thick) image slices correspond to a second thickness which is n times the first thickness. The first (thin) and second (thick) slices are parallel to each other [0029], [0035]. A first display means or port (Figure 2) depicts selected ones of the plurality of second (thick) image slices and a second display means or port (Figure 3) displays one or more of the first (thin) image slices included in the subset used to generate one of the second (thick) image slices being displayed in the first image port or by the first display means [0030], [0037].

With reference to claim 15, the present application discloses a medical diagnostic image method. A plurality of first 2D images of a subject are attained, which first image represent a plurality of contiguous slices of a first (thin) thickness [0035], [0029]. A plurality of second 2D images are generated from subsets of the first (thin) images by merging together the first images in each of the subsets. The subsets include first (thin) images for a number of contiguous slices. The second images represent slices of a second thickness which is greater than the first thickness [0035], [0029]. Regions of the subject are designated by a reviewer for closer review [0035]-[0038]. The second (thick) images are sequentially displayed [0039] for review by the reviewer [0037]. When the designated regions are reached, the first (thin) images are displayed for review by the reviewer [0036], [0037], [0039].

The References of Record

Horiuchi discloses a CT scanning system in which an x-ray beam **40** collimated **22** to a preselected thickness (th) is detected by two detectors **240**, **242** such that data for two slices is received concurrently. The two slices are unequal (column 8, line 30), such as a 3 mm slice and a 7 mm slice (column 7, lines 30-35). During scanning, the patient table is intermittently translated by 10 mm per rotation of the x-ray emission/detection system (column 6, lines 63-65). Thus, data for alternating 3 mm and 7 mm slices are generated. Taken together, the data for the pair of contiguous 3 mm and 7 mm slices is combined **112** to create data for a 10 mm slice. The scanning is done such that the 10 mm slices are contiguous (column 7, lines 28-30). The 3 mm slices, for example, are generated at regular intervals (column 7, lines 48-50), i.e., with 7 mm gaps in between. Because the 3 mm and 7 mm slices alternate, only the separately reconstructed 10 mm slices are continugous and present a full set of slices.

For the 7 mm slices, a low frequency band enhancing reconstruction function is provided which provides good definition in the parenchymal portions of the internal tissue (column 7, lines 39-42). By distinction, for the 3 mm slices, a high frequency band enhancing reconstruction function is used such that the resultant images have good definition in details of the internal tissue (column 7, lines 42-45). Because the 3 mm and 7 mm slices are reconstructed with different filters, there is no motivation to combine the 3 mm and 7 mm images. To the contrary, Horiuchi combines the underlying data and reconstructs the data using the low band enhancement (column 7, lines 38-39).

It is common in the medical diagnostic imaging arts to generate a plurality of parallel axial sections or slices, such as with a CT scanner and display images from this data set in a display having a plurality of view ports. In the present application, the applicants refer the Examiner to their prior patents US 5,371,778 and US 5,734,384 which were incorporated herein by reference, by way of example.

Wood gives the example of an imaging session in which 200 or more sections or slices are generated with a CT scanner [0041]. Wood, throughout the specification, refers to axial sections or planes. Sections as used by Wood and slices as used herein are synonymous. Axial sections (Wood) and axial cross-section slices

(herein) connote slices transverse to a central axis of the subject (vertical slices of a prone patient). Although axial slices are commonly generated, Wood recognizes that the series of parallel sections or planes could be generated in other directions, such as sagittal or coronal [0045]. Although Wood generates an analogous series of parallel slices, which parallel slices taken together represent a volume of the subject, Wood uses this data in a different manner for a different purpose and to achieve a different end result that the present application.

First or axial slice images are displayed in the first view port **510**. However, the second view port **520** does not display a planar image, much less a thick planar image, created by combining together n of the axial slice images displayed in the first view port **510**. Rather, the image in the second view port **520** of Wood is more analogous to the image shown in the third view port (Figure 4) of the present application and described in [0032] of the present application. The second display or view port **520** is a volumetric view of the volume encompassed by the CT sections [0043, lines 4-5]. Thus, as clearly set forth in [0043] of Wood, view port **520** does not represent a slice, but rather a volume. Wood does not explain the nature of the image in view port **520** in detail, but rather assumes that the construction of such an image is known to those in the art. Wood does explain that this volume image includes a horizontal line shown but not labeled in Figure 5 to highlight the slice or section which is displayed in the first display **510** [0046], [0082]. This is analogous to the multi-planar reformatted view of Figure 4 of the present application on which thick slices are denoted by boxes **160** and the thin slices are shown by lines **170**. Thus, the image shown in view port **520** of Wood is analogous to the image shown in the third view port of the present application and claimed in claim 3 (and others) of the present application.

Wood, like the present application, notes that one could examine each of the axial section images in a first view port **510** manually looking for cancerous nodules on the lungs [0050] but acknowledges that this task can be difficult and that cancerous nodules can be frequently overlooked [0050]. Rather than the present application's present thick slice/thin slice solution to this problem, Wood advocates using an automatic nodule locating algorithm [0072]. Cancerous nodules, or at least candidate cancerous nodules found by the automatic operation are identified by

circles, such as circles **541** and **542** of the first view port **510** [0049]. The circles are also displayed in the second display **520** as illustrated more clearly in Figure 13 [0075]. When the operator designates one of the nodules or regions of interest (ROI) that ROI is brought up in the third view port **530**. Using a trackball and mouse, the region of interest in the third view port **530** can be rotated [0076]; [0086]. The ROI is described as having a volume and a diameter [0079] which suggests that the display in the third view port **530** is also a volume display [0079]. That view port **530** displays a volume image is confirmed by [0043], which states that **530** is a magnified and rotatable portion of the volume rendered in **520**.

Thus, the display of Wood illustrates one axial slice in the first view port **510**, a volumetric navigation image in the second view port **520**, and a rotatable volumetric image of an identified ROI in the third view port **530** [0043]. The Examiner does not suggest that Wood discloses combining a plurality of adjacent thin slice images to generate a thick slice image.

The Claims Distinguish Patentably Over the References of Record

Claim 1 calls for the generation of a plurality of first image slices and for the data processor which combines subsets of the first image slices to generate a plurality of second image slices. By contrast, Horiuchi collects data with the 3 mm detectors and data with the 7 mm detectors. The data from the 3 mm detectors is reconstructed into a series of spaced, non-continuous first slices; the data from the 7 mm detectors is reconstructed into a second plurality of non-continuous 7 mm images; and combined data from the 3 mm and 7 mm detectors is reconstructed into a third plurality of images. Horiuchi makes no suggestion of combining the 3 mm images with each other or with the 7 mm images. Rather, the images for each of the 3 mm, 7 mm, and 10 mm images are reconstructed separately. No images are combined.

Second, claim 1 calls for the first images to include n contiguous first image slices. The 3 mm slices of Horiuchi are not contiguous. Rather, they are spaced by 7 mm. Analogously, the second or 7 mm image slices of Horiuchi are not contiguous. Rather, they are spaced by 3 mm.

Further, claim 1 calls for the second image slices to be n times the thickness of the first image slices. In Horiuchi, the second or 7 mm slices are not a multiple of the first or 3 mm slices. The third or 10 mm slices are not a multiple of either the first or 3 mm slices, or the second or 7 mm slices.

Horiuchi reconstructs the thicker and thinner slices using different frequency band enhancing reconstruction functions to emphasize different tissues. Because the 3 mm and 7 mm images differ in more than just width, it is submitted that Horiuchi would not motivate one to combine 3 mm and 7 mm images to obtain the 10 mm images rather than performing a separate reconstruction to generate the 10 mm images. Moreover, because the 3 mm slice images are generated with a different frequency band enhancing reconstruction than the 7 mm slices or the 10 mm slices, it is submitted that combining the Horiuchi 3 mm and 7 mm images is not the equivalent and would not obtain the same resultant 10 mm image as the Horiuchi technique in which the outputs from the 3 mm and 7 mm detectors are combined and reconstructed using the low frequency band reconstruction function.

Wood does not address any of the above-discussed distinctions nor correct any of the above-discussed shortcomings of Horiuchi. Accordingly, it is submitted that **claim 1 and claims 2-5 dependent therefrom** distinguish patentably over the references of record.

Claim 2 calls for the data processor which combines n contiguous first slice images to use a uniform averaging projection. Thus, claim 2 emphasizes the distinction over Horiuchi which does not combine images.

Claim 3 calls for a third view port which depicts a reference image which is viewed from a direction orthogonal to the first and second images. In Horiuchi, all three images are viewed from the same direction. Wood, in which the three view ports illustrate an axial slice, a volume navigation image in a second port, and a rotatable volumetric image in a third view port does not suggest this limitation and does not cure this shortcoming of Horiuchi.

Claim 4 calls for the third view port to superimpose over the reference image graphical representations of the relative locations of the first and second image slices. Again, Horiuchi does not disclose such a limitation and Wood, with different images in its three view ports, does not cure this shortcoming.

Claim 6 calls for n of the first slice images to be combined into each second slice image. Horiuchi does not combine images. Rather, Horiuchi combines data and reconstructs individual images with different properties.

Because the images reconstructed by Horiuchi have different properties, it is submitted that there is no motivation to combine some of the images of Horiuchi. Moreover, even if one were to combine the 3 mm and/or 7 mm images of Horiuchi which are reconstructed to have different properties, one would not achieve a 10 mm image with the same properties as the 10 mm image of Horiuchi.

Further, claim 6 calls for the thickness of the second or thicker images to be n times the first thickness. None of the 3 mm, 7 mm, and 10 mm images are a multiple of the other.

Wood does not address the combining of images, combining n thinner images to generate a thicker image, or a thicker image having n times the thickness of one of the images which was combined to generate it. Accordingly, it is submitted that **claim 6 and claims 7-14 dependent therefrom** distinguish patentably over the references of record.

Claim 10 calls for a means for detecting small objects in the subsets and projecting the outlines of the projected small objects. Horiuchi is devoid of any suggestion of locating small objects or outlining them.

Claim 15 calls for obtaining a plurality of first images of a first thickness. Horiuchi generates a plurality of 3 mm images and a plurality of 7 mm images. It is unclear whether the Examiner considers the 3 mm images to be the first images or the 7 mm images to be the first images. Because the first images are required to be contiguous and because the first images are required to be slices of a first thickness, it is clear that the 3 mm and 7 mm images cannot be the first images. The 3 mm images are not contiguous with each other, but are separated by 7 mm images and vice versa. The 3 mm and 7 mm images are not of the common first thickness.

Next, claim 15 calls for generating a plurality of second images by merging subsets of the first images together into slices of a second thickness. Horiuchi does not suggest combining the 3 mm slices nor does Horiuchi suggest combining the 7 mm slices.

Further, claim 15 calls for designating regions of the subject for closer review and then sequentially displaying the second images for review until the designated regions are reached and displaying the first images. Horiuchi does not teach such a method of reviewing the images. Rather, Horiuchi uses different frequency band enhancing reconstructions for the 3 mm and 7 mm images such that they have different image properties. Not only do these different image properties mitigate against combining the 3 mm and 7 mm images, but also mitigate against the claimed method of stepping through the thicker images until a region of interest is reached. Rather, generating images with different properties suggests that all images should be reviewed and in no way suggests the claimed display sequence.

Wood does not address the combining of images nor display sequences for displaying combined and non-combined images. Rather, Wood suggests using an automatic defect locating routine and then jumping directly to the defects. Accordingly, it is submitted that Wood does not cure or even address any of the shortcomings of Horiuchi.

Accordingly, it is submitted that **claim 15 and claims 16-18 and 20 dependent therefrom** distinguish patentably and unobviously over the references of record.

CONCLUSION

For the reasons set forth above, it is submitted that claims 1-18 and 20 distinguish patentably and unobviously over the references of record. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, he is requested to telephone Thomas Kocovsky at (216) 861-5582.

Respectfully submitted,

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